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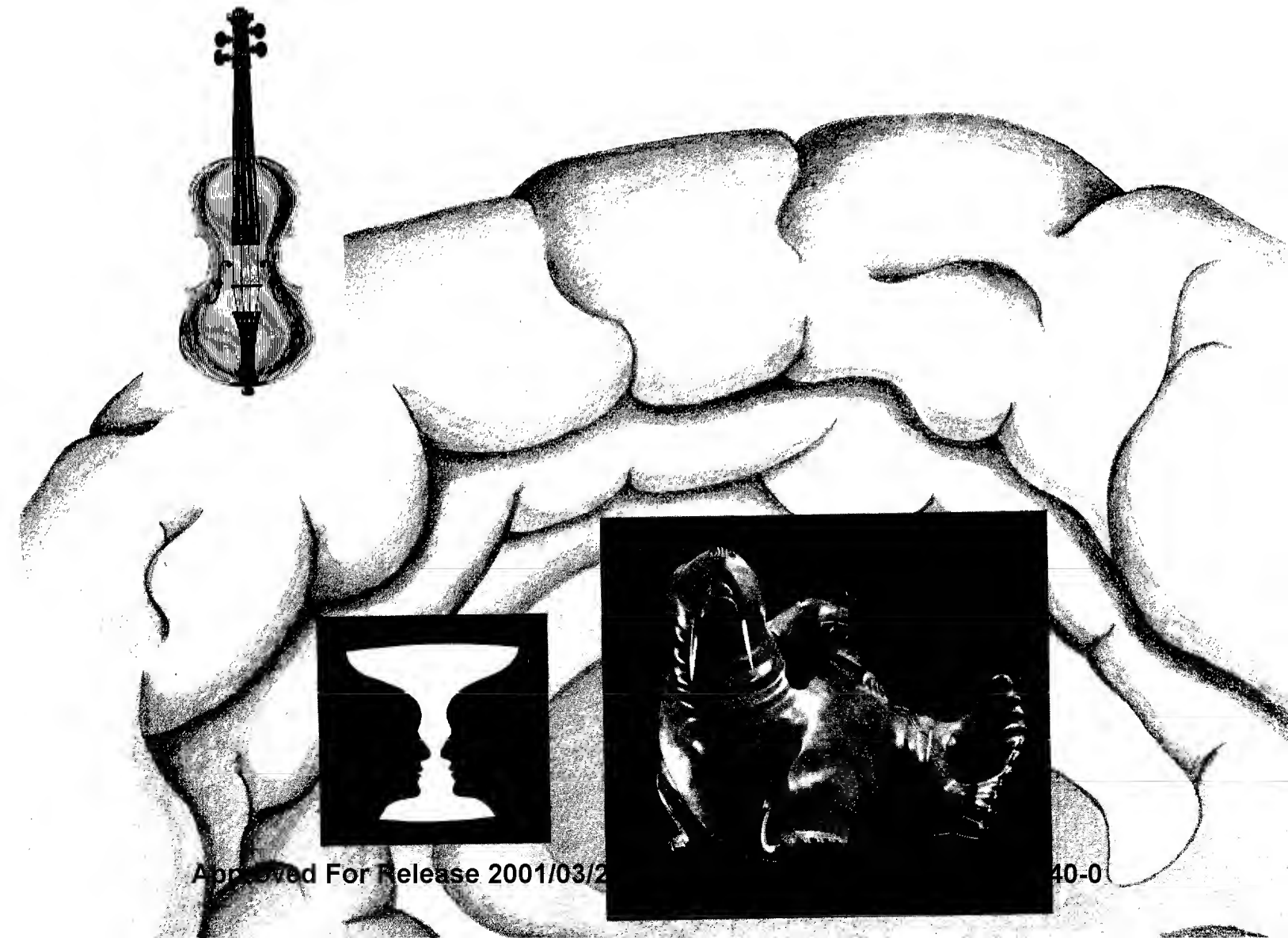

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ADVANCES IN SLEEP RESEARCH, Vol. 2—Elliot D. Weitzman, M.D.—Spectrum (Halsted Pr), 1976, 236 p., illus., $20. Critical reviews of multidisciplinary research, ranging from discussion of neurophysiological substrates of the changes in respiration during sleep, to "dream detector" and comparison of laboratory and home dreams collected by REMP-awakening technique.

THE ARCHAEOLOGY OF NORTH AMERICA—Dean Snow—Viking Pr, 1976, 272 p., color plates, 175 photographs by Werner Forman, maps, chronologies, $18.95. Explores the cultural traditions, artifacts and sites of the various archaic and historical cultures that once inhabited the country, from Paleo-Indians of the Great Plains to Aleuts and Eskimos in the Arctic.

BEYOND ECONOMIC MAN: A New Foundation for Microeconomics—Harvey Leibenstein—Harvard U Pr, 1976, 310 p., diagrams, $15. The author introduces modern psychological concepts to microtheory by using individuals instead of groups as his basic units of study, adding an innovative central variable, *effort,* as the X factor providing the most significant results.

GAMES FOR RAINS, PLANES AND TRAINS—Gyles Brandeth—Greene, 1976, 126 p., illus., $7.95; paper, $4.25. Family games and brainteasers to keep young minds alert and occupied.

SCIENTIFIC INSTRUMENTS—Harriet Wynter and Anthony Turner—Scribner, 1976, 9x12, 240 p., 300 color and b&w photographs, $27.50. Provides illustrations and brief descriptions of antique instruments employed in astronomy, navigation, surveying and optics.

THE STRESS OF LIFE—Hans Selye, M.D.—McGraw, 1976, rev. ed., 542 p., illus., $8.95. The author's original work on his research findings of the body's nonspecific response to stress, called *general adaptation syndrome* (G.A.S.), expanded and updated with new research findings, glossary and annotated references.

TEXTBOOKS

BASIC FOOD CHEMISTRY—Frank A. Lee—AVI Pub. Co, 1975, 430 p., diagrams, tables, $24 paper, $12. Undergraduate text, covers the field from discussion of photosynthesis, carbohydrates, proteins, enzymes and lipids to natural colors, browning reactions, fermentation and specific food products.

ENZYMES: Basic Biology Course, Book 7—Michael Tribe, Michael E. Eraut and Roger K. Snook—Cambridge U Pr, 1976, 8x12, 112 p., diagrams, $15.95; paper, $5.95. Individual learning text on enzymes.

INTRODUCTION TO PHYSIOLOGICAL PSYCHOLOGY—Francis Leukel—Mosby, 1976, 3rd ed., 526 p., diagrams, $14.75. Undergraduate text for psychology majors, intended to develop understanding of physiological concepts in other specialized fields, deals with the internal organization of life, integrating and response systems, the senses, and adaptive behavior.

THE MAMMALIAN ALIMENTARY SYSTEM: A Functional Approach—David S. Madge—Arnold (Crane-Russak), 1976, 206 p., photographs, diagrams, $22.50; paper, $12.75. Text summarizes the process of extracellular digestion and outlines progress made in understanding intracellular digestion and transfer of food and water molecules in the small intestine.

MATHEMATICS, THE MAN-MADE UNIVERSE: An Introduction to the Spirit of Mathematics—Sherman K. Stein—W H Freeman, 1976, 3rd ed., 588 p., illus., $12.50. Rewritten and modernized text includes new chapter on probability and chance phenomena.

ORGANIC CHEMISTRY—Norman L. Allinger et al—Worth, 1976, 2nd ed., 1024 p., illus., $19.95. Tested and improved text, begins with the structure of the main kinds of organic molecules, their physical properties, electron distribution and spectra, examines the reactions these molecules undergo, covers organic synthesis and natural products.

PATTERNS IN HUMAN GEOGRAPHY: An Introduction to Numerical Methods—David M. Smith—Crane-Russak Co, 1976, 373 p., diagrams, tables, $12. Addressed to the introductory-level student and non-academic reader, demonstrates through illustration a wide range of commonly used numerical techniques.

PHOTOSYNTHESIS: Basic Biology Course, Book 6—Michael A. Tribe, Michael R. Eraut and Roger K. Snook—Cambridge U Pr, 1976, 8x12, 85 p., micrographs, diagrams, $13.95; paper, $4.95. Deals with the capture of light energy from the sun by green plants, and the transformation of this into chemical energy.

PLANT CELL BIOLOGY: An Ultrastructural Approach—Brian E. S. Gunning and Martin W. Steer—Crane-Russak, 1975, 8x12, 108 p., 200 micrographs, diagrams, paper, $8.95. Excellent collection of fully captioned illustrations depicting the ultrastructure of plant cells, useful for classroom displays illustrating cell biological topics.

STRESS TRANSIENTS IN SOLIDS—John S. Rinehart—HyperDynamics, 1975, 230 p., diagrams, paper, $8.95. Text introduces the principles of propagation and interaction of stresses generated by impacts and explosions.

UNDERSTANDING GENETICS—Norman V. Rothwell—Williams & Wilkins, 1976, 500 p., photographs, drawings, diagrams, tables, $14.95. Introductory text gives a solid foundation in the basics of molecular genetics.

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OF THE WEEK

RESEARCH NOTES

ARTICLES

DEPARTMENTS

COVER: The right hemisphere of the human brain is thought to play an important role in creativity, intuition, art, music, spatial abilities and a number of other things. These findings are supported by various lines of research, including a study of the Inuit Eskimos and their art. See story p. 218. (Collage: Dale Appleman)

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LETTERS

Moon rocks at school

I would like to add my comments to Jonathan Eberhart's article "Moon Rocks Go to School" (SN: 4/26/75, p. 276), since I have just completed participation in this program. I congratulate NASA on this program to make available lunar materials for study at the public level. The use of these thin sections provided my students the opportunity to compare lunar mineralogy with that found in terrestrial rocks. The comparisons were striking, and the overall interest generated in my students cannot be duplicated by the best of color slides. By making these specimens available for public study, NASA has truly brought the moon home to the people.

Paul P. Sipiera
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Acronymania

The term "Acronymania" (SN: 1/31/76, p. 67) most appropriately describes the affliction, common among management-oriented personnel in government, private industry, and civic organizations, that is responsible for the disturbing proliferation of acronym production. Something ought to be done to curb this distressing malady. Perhaps thought should be given to forming a National Association to Undertake the Systematic Elimination of Acronymania.

S. O. Nelson
Lincoln, Neb.

Ongoing debate

John Douglas's articles on "The Great Nuclear Power Debate" will unquestionably be recorded by history as one of the finest, fairest attempts to get at the facts in this emotionally warped technological issue.

The hysterical allegations condemning nuclear energy cannot be borne out by carefully analyzed fact and stem from our basic societal problem today: fear of the unknown coupled with a distorted distrust of government and industry. The Riley and Cohen comments of Feb. 14 are but an example of this pervading problem.

This phenomenon of our times is triggered by naive recognition of and childish disillusionment with organization, institution and establishment containing elements of human frailty. These frailties have always been present and probably always will be. As increasingly wider segments of the population spectrum seek more than superficial understanding of the complexities of today's society, of which technology is a significant fraction, they grapple, like a teenager discovering sex, with the inescapable need for perspective and wisdom necessary for the logical and rational integration of their new found knowledge.

But the human frailties that frighten our intellectually adolescent observers are, unfortunately, omnipresent and can be found both in the condemner and the condemnee. This is evidenced by Riley's comments where he advocates emotional outcry at the expense of intellectual integrity and Cohen's inference that data are not important in crucial decisions.

These obviously intelligent and well-meaning people cannot really mean what they say. Are they not both victims of our most ancient and prevalent human frailty – that the end justifies the means—that distortion and non objectivity are "A-OK" so long as they satisfy their personal set of values? Shame, Shame!

This sort of fuzzy thinking on the part of amateur crusaders in the midst of extremely complicated technology is the very reason we must have Douglas's "honestly defined and clearly presented" fact in the resolution of any technologically based issue.

P. F. Grindrod, Ph.D., Ch.E., P.E.
Madison, Wis.

Left hand of life

The article "Physics and the Left Hand of Life" (SN: 11/29/75, p. 340) is somewhat misleading. Namely, a relationship between the "left hand of life" and the "left-handedness of weak interactions" has been proposed as early as 1957 by Yester and Ulbricht. Though they obtained no unequivocal results to prove their hypothesis, quite a few papers have been published in the past several years, furnishing evidence that β^+ and β^- particles interact differently with L and D molecules. In order to understand this differential interaction, a model has been proposed according to which the orbital electrons in optically active molecules have a non-zero spin-polarization with respect to their velocity. The contribution of weak interactions to the binding energy of L and D molecules has been calculated too (10^{-12} eV).

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Laser Fusion: Toward 'Brand X'

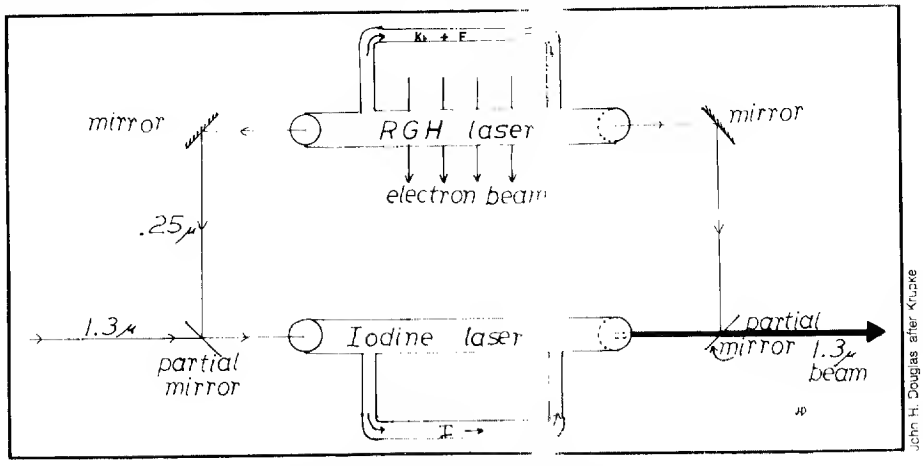
In roughly three years, the idea of laser fusion has grown from a germ of speculation, discussed only by a few specialists, to a heavy-weight contender of "big science"—with a proposed budget of just over $100 million for next year and a small army of engineers talking about "milestones" and "systems approaches." Both topics were widely discussed last week at a joint technical symposium of the Society of Photo-Optical Instrumentation Engineers and the Society of Photographic Scientists and Engineers, in Reston, Va. Perhaps more important was analysis of the impact a new lasing technique may have on producing a workable fusion system.

The "milestones" of laser fusion were set forth by John D. Hunsuck, project director for the Energy Research and Development Administration (ERDA). He predicts "scientific breakeven" (fusion energy out equal to laser energy in) by 1981-82 and an operating test system by the late 1980s. A demonstration plant may be completed by the mid-1990s, he said, but the final thrust to such a practical system will be "a long, hard haul." At that point, the main concern may be how to find materials capable of withstanding the intense neutron flux that results from fusion.

Before any of the milestones beyond scientific breakeven can be reached, however, a fundamental change must occur away from present experimental systems—the combination of lasers and target pellets being used today cannot simply be scaled up to higher power levels. This realization has led some experts to speculate on the need for a high-powered "Brand X" laser, probably radiating in the visible spectrum rather than in the infrared as in today's experimental devices. This speculation was discussed at the Reston conference by W.F. Krupke of Lawrence Livermore Laboratory.

According to the Brand X theory, the simple spherical target pellets now in common use would have to be compressed by some as yet undiscovered laser that could achieve 10 percent energy efficiency at around 0.5 microns (green light). Krupke, however, points to an alternative stratagem. He says more complex targets might ease the restrictions to allow use of an infrared laser (1.0 to 2.0 microns) with an efficiency as low as 1 percent. (Long wavelength photons of infrared light are inherently less energetic and capable of compressing a pellet than the photons of visible light.)

Complex pellets, containing multiple layers and heavy elements in addition to the fusion reactants, have already apparently found increasing use (SN: 6/14/75, p. 384). Now, within the last few months, a new type of laser has been developed that may aid the search for Brand X. It is the rare gas-halogen (RGH) laser, which radiates in the ultraviolet and can be used to pump other lasers to produce desired wavelengths in either the visible or infrared spectrum. (Brand X would almost certainly be a flowing gas laser, to remove heat generated.)



An RGH laser pumps iodine laser: Similar combinations may lead to fusion system.

So-called rare gases (krypton, argon, etc.) do not ordinarily form any chemical compounds, but when their atoms absorb energy they can form loose molecules with the very reactive atoms of the halogen gases (fluorine, chlorine, etc.). To create these energetically excited states, the reactants are bombarded with an electron beam in the presence of a third gas, which helps transfer the energy. Once formed, the new molecules (say, KrF) quickly dissociate again, releasing energy (in this case, ultraviolet light of 0.25 microns).

The dissociation is so fast that not enough energy can apparently be stored by RGH lasers for use directly in causing fusion, so the ultraviolet light is used instead to "pump" a laser of some other material. One of the first materials that appeared to have the right combination of properties (to be pumped by an RGH laser and in turn to lase at approximately the right wavelength) was iodine, which emits light in the "near" infrared (1.3 microns). Several laboratories are now exploring this laser combination, but an even more promising set-up appears to be emerging. Calculations show that if an RGH laser can be used to pump the vaporized atoms of certain "rare earth" elements (say, terbium), they should lase right in the middle of the visible spectrum (in this case, green).

It is still too early to tell whether an RGH-pumped rare earth laser will turn out to be Brand X—the first experiments are just now in progress—but the new technique has already opened several new avenues of approach. In an interview, Krupke said of the RGH lasers: "It looks like they will have a major impact on the laser community, both in isotope separation and in fusion." He estimated that in perhaps as little as two years, a decision can be made on what combination of targets and lasers to use in future power-generating fusion reactors.

Meanwhile, in the corridors, talk turned to what the Soviet Union is up to in this field. Administration of the Russian laser fusion program has reportedly shifted from a pure research institute into the USSR equivalent of ERDA, and communication on the subject—once quite open—has suddenly grown quiet. Speculated one knowledgeable scientist: "Either they've found out how to do it, or they've run into trouble." ❑

Electron beam fusion: Soviets claim advance

Although the Soviets are extremely close mouthed (and close with their typewriters too) about their progress in controlled thermonuclear fusion research, occasionally something surfaces that gives a hint of an idea of what approaches they are into.

One such avenue that they have chosen to follow is a variant offshoot of the laser fusion idea in which beams of accelerated electrons instead of laser light are used to implode the target pellets. This idea was taken up because it seems it might be able to get around some of the difficulties that are beginning to appear in the laser-fusion business. (It seems easier to couple the electron energy into the targets, and the targets can be larger.) Both the United States and the Soviet

Union are energetically pursuing laser fusion, and at the same time both have taken up electron-beam work. Now, workers at the Kurchatov Institute in Moscow, where Soviet fusion work of all kinds seems to be concentrated, have claimed an important advance in electron-beam fusion experiments.

The report came not in a scientific journal, but in an article in the March 10 Pravda written in connection with the 25th Communist Party Congress. The article dealt mostly with other thermonuclear fusion experiments underway at the Kurchatov Institute (notably tokamaks) but devoted one paragraph to the electron-beam work.

The paragraph claimed the achievement of some fusions. It said electron beams had compressed fuel pellets containing deuterium to 100 times their original density. The crushing raised the temperature of the fuel to nearly 11 million degrees K. The reaction gave off more than a million neutrons, which the Russian physicists claim as evidence that fusions actually took place in the fuel.

The number of neutrons, if in fact they do come from fusions, is still a long way from what is necessary for a practical device producing useful energy, but the achievement is a significant step, in the opinion of Gerold Yonas of Sandia Laboratories in Albuquerque, who heads the American program in electron-beam work. On receiving the Pravda report, Yonas telephoned the leader of the Soviet group, Leonid I. Rudakov, to determine whether the report was accurate, to offer his congratulations if so, and to seek further information. He was assured that the report was correct, offered his congratulations and got no further information.

What Yonas was especially interested in was the diagnostic methods used at the Kurchatov Institute to determine what happened in the imploded fuel pellets. There are a number of possible sources of neutrons in such events, and it takes delicate methods to be sure that the neutrons seen are really those thrown off as excess when two nuclei fuse, and not the result of some other process. Rudakov would not describe the diagnostic methods, but referred Yonas to a forthcoming scientific publication in an unspecified journal at an unspecified date.

The American program has so far succeeded in crushing dummy pellets but has yet to experiment with targets filled with fuel, which in this case will be a mixture of deuterium and tritium. The American effort, as described by Yonas's colleague M. J. Clauser at a meeting last fall, uses electrons of 100 million electron-volt energy and protons of 10 million electron-volts to irradiate the targets. What the energy of the Soviet electron beams may be is not known, nor have they said whether they are also trying protons or any of the other ions that have been suggested. [ ]

Miniaturizing flies with membrane leaks

Three California biologists have discovered an enzyme from bee venom that can cause fruit fly larvae to grow up tiny. The miniaturizing effect is due to the enzyme's action on cell membranes; it causes them to leak. Although this fly "shrinking" phenomenon can carry the imagination off to science fiction scenarios, the enzyme will be mainly a tool for basic membrane research. Sadly, for those inclined to wonder about such applications, it won't be at all useful for shrinking overweight humans.

Cell biologists Peter H. Lowy, Herschel K. Mitchell and Ursula W. Tracy of California Institute of Technology report the leak phenomenon in the April issue of TOXICON. Lowy and Mitchell discovered the miniaturizing enzyme purely by accident five years ago. They were studying a bee venom enzyme that causes biological molecules to break down. They injected a control group of fruit fly larvae with a different venom enzyme. To their amazement, they found that the injected larvae hatched into perfect, miniature adults that produce a second generation of normal-sized flies. The team has since studied the action of this enzyme, which is called phospholipase A-2, and can now state that it causes permeability changes—leaking.

In order to determine the mode of action, the team immersed human cancer cells (HeLa cells), red blood cells and mitochondria (metabolic organelles) into weak solutions of phospholipase A-2. The enzyme has no apparent effect on the red blood cells, but it attaches to HeLa and mitochondrial membranes and causes them both to leak. Mitochondria have a double membrane, and the inner layer allows larger than normal molecules to pass through in the presence of phospholipase A-2. The HeLa cells accumulate lipid droplets. This is due either to a change in membrane permeability or to a release of lipids within the cell, the team suggests.

The miniaturizing effects on fruit fly larvae are probably a result of membrane permeability changes, too, Mitchell says. Insect larvae are essentially eating machines, but fruit fly larvae injected with phospholipase A-2 don't eat at all. When they metamorphize, there is just too little larval tissue to create full-sized adults. The insects' lethargy is probably due to muscle and nerve dysfunction resulting from leaky membranes.

Phospholipase A-2 in bee venom and its counterpart in cobra and rattlesnake venom seems structurally similar to the phospholipase present in normal cell membranes. This similarity suggests, Mitchell says, that normal cell phospholipase may have a permeability regulating function. The bee venom enzyme should be a useful tool for studying that normal membrane regulation.

As for miniaturizing overweight humans, Mitchell replies to the somewhat facetious question, "the enzymes would be useless—in fact, worse than useless." The enzymes will arrest the growth of insects at a certain stage of development, but "if an organism is already big, there is no reason to believe it will get smaller." Besides, you just wouldn't want to do this to a person. The change in his membranes might cause him to stop eating, but he also might stop breathing. Breathing is a membrane function, too." [ ]

The hidden energy of silent quakes

It's almost as though violent earthquakes, with their rumblings and sudden upheavals, are just diversionary tactics. According to geophysicist Hiroo Kanamori of the California Institute of Technology, much of the real, large-scale earth-moving along the faults and trenches surrounding the Pacific basin seems to reveal itself only in slow, ponderous "silent earthquakes," whose seismic waves don't even show up in the measurements used to rate quakes on the Richter scale.

Kanamori's research was reported this week at an international symposium conducted by Columbia University at Arden House in New York, in honor of the late Maurice Ewing, whose name is associated with many of the great discoveries in marine geophysics in the last 30 years.

His findings are based on a study of the "repeat time"—the time between periods of heavy quakes—for the various earthquake zones around the basin. His findings, coupled with plate-tectonic theory, suggest that the major recorded quakes have not been sufficient to account for all or even most of the earth movement that plate-motion studies indicate has been taking place.

Off the coast of Japan, for example, where the Pacific crustal plate is said to be thrusting under the Asiatic plate, the repeat time, by Kanamori's calculations, is about 100 years. (The entire subduction zone broke within the last 25 years, while the previous sequence of breaks was between 1850 and 1900.) Each major quake sequence, he says, involved a relative slip between the plates of 6 to 9 feet, yet the Pacific plate advances beneath the Asiatic plate about 30 feet every 100 years. The difference, Kanamori concludes, must be due to slippage without the accompanying ground shaking. In other words, the silent quakes.

The seismic waves of the silent quakes as Kanamori defines them are those with periods of 300 seconds or more—frequencies, that is, of 12 cycles per *hour*

and lower. The commonly monitored waves of higher frequencies are usually produced, according to plate tectonics theorists, when the relative plate movements somehow stick, releasing the tension in jerky spasms. The smoother movements produce the low-frequency waves.

Further evidence in Japan shows up in measurements by Caltech geophysicist Kunihiko Shimazaki, who has found that crustal tilting and lifting in northern Japan can account for only 20 percent of the known plate slip. Somehow, he believes, the Pacific plate is creeping under the Asiatic one without deforming.

Off the Alaskan coast, the repeat time is not definitely known, although 1,000 years has been suggested, during which time plate subduction amounts to about 120 feet. The Alaskan quake of 1964 involved 30 to 60 feet of displacement, only a fourth to a half of the total if the 1,000-year repeat time is correct. The San Andreas fault in California also shows gradual, non-quake-related creep, but the repeat time for quakes along the fault is not known, says Kanamori, so the "silent quake" theory cannot yet be evaluated.

One of the major implications of Kanamori's work is for predictions of tsunami, or tidal waves. Sometimes, he says, a quake can appear small on the Richter scale, which incorporates only higher-frequency measurements, yet have a total energy that is very large. An 1896 quake at Sanriku, Japan, for example, produced only minor shaking, but it was accompanied by one of the most devastating tsunami ever to strike the country. Realization of the danger of low-frequency, "silent" quakes, Kanamori says, should be incorporated into tsunami warning systems, which at present are based largely on Richter-type measurements of earthquake magnitude. □

Washington's era of Metro begins

John H. Douglas

Spacious stations, comfortable rides greeted Washington Metro's first passengers.

When ground was broken in 1969 for beginning construction on Washington, D.C.'s, metropolitan rapid transit system, Metro, then-President Nixon expressed a common hope of planners trying to stem decay of the nation's capital: "More than a subway will begin . . . a city will begin to renew itself, a metropolitan area to pull itself together." Thus, with the opening this week of the first 4.6-mile segment of Metro, one of the boldest urban renewal experiments ever attempted got underway.

The urgent need for something to halt the spread of squalor has long been apparent. A study of the Metro idea, conducted by Development Research Associates, concluded that Washington might benefit more from such a project than any other metropolitan area in the United States. The report showed the city to be "ideally suited for rapid rail transit," with a strong downtown, relatively compact suburbs and high transit ridership.

The initial line—less than five percent of the projected system—will hardly make a dent in the life of the capital, but Metro officials hope that its very attractiveness and success will spur local governments to raise the money needed to complete the rest. Estimated costs have soared from $2.5 billion at the start to $4.67 billion currently. Some suburban governments are considering pulling out of the cooperative effort, construction is limping along on federal funds left over from highway projects, and overall progress has been held up by strikes, storms, management problems and lawsuits.

Despite inevitable start-up problems, opening day was generally a success, with more than 50,000 people showing up for free rides. They were treated to the fastest, most comfortable journey in town—once technicians could get all the train doors closed—a task that once took up to 40 minutes. (Heavy loads apparently buckle the cars just enough to jam the doors.) The cars have carpeting, plush, two-inch-thick padded seats (though some will have to be replaced because of potential fire hazard), year-round air conditioning (which also needs to be tinkered with) and steel wheels well suspended for a smooth, silent ride (though the brakes must be adjusted so they don't jam under heavy loads). Most problems had been worked out by the time the first paying passengers rode on Monday, in numbers twice as high as expected.

Underground stations are built inside long, continuous arches, indented like wrap-around waffles for noise suppression. Platforms are set away from walls to prevent vandalism and have been cleared of pillars and hiding places that could invite muggers. The whole effect, in the words of one architecture critic, is "a serene kind of beauty."

To cut down noise to surrounding areas, tracks along some segments are supported on pads that absorb the vibration of passing trains. Tracks are also welded, so there is no "clickity-clack." In particularly sensitive areas, the whole concrete track platform is suspended to keep noise from disturbing people in buildings above. Inside the subway cars, sound levels are about the same as in a good automobile, except for moaning brakes.

Already one can begin to see improvement in neighborhoods bordering on prospective Metro lines, and the system is eventually expected to return $3 for every $1 invested, including increased property taxes. (In Toronto, a 4.5-mile system costing only $67 million sparked a $10 billion building program.) But the overall impact of Metro on the life of the community will depend on how much of the proposed system is eventually finished. At present, about half the planned 99.8 mile system is under construction or completed, including 42 of 87 proposed stations.

Commuters can begin to take advantage of the new rapid transit—supposedly about four times faster than a taxi—by driving to the only above-ground station along the new line. There a parking lot and "kiss and ride" area (drop-off point for commuters) have been provided; later a complete rerouting of bus lines will provide an integrated system of area-wide transportation. The next section of line is scheduled to open next year, which will include service to National Airport.

Meanwhile, this summer's expected flood of tourists may not find Metro too helpful. As they board at the Union Station Bicentennial Center, the new line can only take them into a nondescript Northeast neighborhood or across to the bustling commercial district—bypassing the Mall and popular monuments. Still, come July, Metro may be one of the safest, most comfortable places in town. □

NSF faring better in Congress

Congressional supporters of the National Science Foundation were caught by surprise last year by the onslaught of criticism that first surfaced as charges of sponsoring "silly" research (SN: 3/15/75, p. 165) and eventually led to passage of the so-called "Bauman amendment," which would have required prior Congressional approval of all NSF grants (SN: 4/19/75, p. 253). After a long, tedious summer of debate, the amendment was finally defeated (SN: 8/9/75, p. 87), following elimination of some controversial programs. This year, the defenders were better prepared.

At the heart of the controversy is dissatisfaction among some conservatives over the choice of specific projects for funding—especially programs in the social sciences that appear to them to have a liberal bias. Leading the opposition has been Rep. John B. Conlan (R-Ariz.). Last week Conlan offered an amendment cutting all funds ($1.4 million) for precollege curriculum development, testing and evaluation. (No funds had been proposed for course implementation, pending further NSF reorganization.)

Two ongoing projects would be affected by the March 25 proposal: the Individualized Science Instruction System (ISIS), a set of minicourses on the physical sciences; and the Human Sciences Program (HSP), a social science series for the middle grades. Conlan charged ISIS would give "unfair advantage in the commercial marketplace" to the company chosen to market it. As for HSP, he called it "a sophisticated and lethal assault on Judaic-Christian family values, privacy of students and their families, and the mental health and developments of young adolescents." By instructing youngsters to interview family and friends and discuss their attitudes in class, HSP would "turn classrooms into gigantic gossip mills where everyone's personal attitudes and behavior are recorded in school files for open discussion and dissemination."

Supporters of the original authorization argued ISIS was being turned over to a private company in accordance with long-established procedure, through competitive bidding. They responded to criticism of HSP with a detailed analysis of the course objectives and the favorable report of a broadly based review committee. Apparently convinced, the House defeated Conlan's amendment, 232 to 160.

A new amendment by Rep. Robert E. Bauman (R-Md.) was similarly dispatched. Rather than again asking that every grant be subjected to prior congressional review, he proposed that individual congressmen should have the authority to demand documentation relating to all "activities, programs, grants or contracts" of NSF. Opponents argued that such authority already resides in the appointed oversight committees and that to allow individuals to essentially conduct private investigations of NSF not only would disrupt its operation but also would probably be unconstitutional. The amendment was defeated, 257 to 136.

The House action left NSF with authorization to spend $811 million in fiscal 1977—about $1 million less than the President had requested but still up 11 percent over last year. Some $9 million has been cut from the originally proposed research budget and added to the science education budget. Speaking for the Science and Technology Committee, Chairman Olin E. Teague (D-Tex.) and Rep. James W. Symington (D-Mo.) said the revised budget would still stem the downward trend in support of basic research (now some 20 percent below 1967 levels, in terms of purchasing power) and demonstrate the committee's concern over recent indications that Americans are becoming "illiterate" in technical matters.

In the Senate, however, Sen. Edward M. Kennedy (D-Mass.) is proposing a total NSF budget increase to $851.4 million. His bill would provide funds for both curriculum development *and* implementation, new aid to science students and intensified efforts to increase women and minorities in science. Thus, NSF has apparently weathered its year-long congressional crisis and may even be in line for new support as a result of a perceived decline in national science literacy. □

Quote of the week

In the course of what may be his last debate on an NSF appropriations bill (see accompanying article), Rep. Charles A. Mosher (R-Ohio), the retiring ranking minority member of the House Science and Technology Committee, rose to reply to media reports about "silly" research. A reporter, editor and publisher for 34 years before entering politics, Mosher spoke "an indictment of my own news profession" as he condemned uncritical publication of a list of funny-sounding grants.

"The fact that the news media, hundreds of editors throughout the country, picked up that list from a propaganda source and published it without questioning the facts behind it is, to me, a supreme example of irresponsibility and demagoguery on the part of some lazy newspaper editors and lazy reporters. . . . Any editor worth his salt would at least investigate the validity of that list before he published it."

He defended specifically two research projects now making a drubbing in the press: a study of how men get distracted by girl-watching while driving and a project involving rat copulation, which has already gone on nine years. The first, he noted, is only one small part of a large study of human aggression; the latter may provide "the basis for the eradication of this scourge of rats which has beset human beings now for centuries." □

Witchcraft in Salem: A fungus in the rye

The first arrests were made in February, and by June the jails for miles around were crowded with prisoners awaiting trial. By September, 19 men and women had been sent to the gallows, and one man had been pressed to death. This grisly chain of events, generally known as the Salem Witch Trials, shook Massachusetts in 1692. But not until now has there been a comprehensive explanation of what may have caused the witch hunt. According to Linnda R. Caporael of the University of California at Santa Barbara, it was not Satan but ergot, a fungus with LSD-like properties, that bewitched eight young Salem girls.

In December 1691, the eight girls were all afflicted with unknown "distempers." Their behavior was characterized by disorderly speech, odd postures and gestures and convulsive fits. Local physicians could find no explanation for the illness, but in February, one doctor finally suggested that the girls might be bewitched. Shortly thereafter, explains Caporael in the April 2 SCIENCE, the girls made accusations of witchcraft against several women in the village. A flood of accusations followed.

Repeated attempts to explain the ghastly goings on in Salem have failed. Fraud, politics, Freudian psychodynamics, clinical hysteria and even the existence of witchcraft have all been proposed, but no one explanation has been able to account for all of the facts as well as Caporael's ergot hypothesis does.

Ergot grows on rye, a well-established cereal crop in 17th-century New England, and ergotism (long-term ergot poisoning) was once a common condition resulting from eating contaminated rye bread. The symptoms of ergotism include crawling sensations of the skin, tingling in the fingers, vertigo, buzzing in the ears, hallucinations and convulsions. All these symptoms were mentioned in the trials and blamed on witchcraft. Caporael's research points out that growing conditions were favorable for ergot just prior to the outbreak, and that the girls could easily have eaten contaminated bread (with 10 percent the activity of LSD).

"The utmost caution is necessary in assessing the physical and mental states of people dead for hundreds of years," Caporael warns, but her physiological explanation certainly answers more questions than does either demonic possession or witchcraft. □

TECHNOLOGY

From our reporter at the symposium of the Society of Photo-Optical Instrumentation Engineers and the Society of Photographic Scientists and Engineers at Reston, Va.

State of a burgeoning art

Time was when some physics teachers steered their students away from optics "because nothing ever happens" in that venerable field. The coming of the laser began to change all that. Now there is hardly any field in which new discoveries follow each other more quickly or more swiftly move from the laboratory to the commercial production line. And among many new subspecialties, none, perhaps, is changing faster than the field of fiber and integrated optics, which promises to revolutionize communications (SN: 7/19/75, p. 44 and 7/26/75, p. 60).

All the specific elements for integrated optical circuits have now apparently been demonstrated individually. What remains is the difficult task of developing new techniques for growing the complex "chips" to combine them all, and of finding reliable ways of connecting them to fibers. Specifically, a thin-film laser has apparently been developed to the point that it is expected to be commercially available soon from a Japanese firm. What will be perhaps the first demonstration of a complete optical circuit in the United States is expected in 1978-79, when the Navy finishes a billion-bit-per-second data network at its Electronics Laboratory Center.

Simpler applications of existing optical communications systems are rapidly gaining acceptance. In Japan, a power company has reportedly installed two separate optical networks, with fibers that can be strung near high-voltage electrical lines without suffering interference. This July the U.S. Navy is scheduled to demonstrate an aircraft in which 1,890 feet of wire has been replaced by 224 feet of optical fibers—weighing only one-fourteenth as much, at a system cost of $60,000 less. An experimental optical telephone system is operating in Atlanta. In Dorset, England, a police station has been outfitted with an optical communications system.

In interviews with SCIENCE NEWS several scientists expressed concern over a growing lag in American industry application of this new technology, which essentially originated in the United States. As one put it: "Japan is pulling ahead of us in optical devices the same way they did in transistors."

Fighting fire with FLIR

Two major obstacles to more effectively fighting wildfires have been how to find "hot spots" where no flame is showing and how to use aircraft at night, when calmer wind, lower temperature and higher humidity make the going much easier. Herbert J. Shields of the U.S. Forest Service's Equipment Development Center reported on a successful two-year experiment aimed at adapting sophisticated military avionics equipment to solve the problem.

First came the recently declassified night vision goggle (NVG), weighing less than two pounds and worn continuously by a helicopter pilot to see well enough to fly with only partial moonlight. The first successful demonstration of night fire suppression using the NVG occurred on August 28-29, 1974, in San Bernardino National Forest. The project became fully operational in Southern California in 1975. Several successful search and rescue operations at night were also made possible by the goggles.

Late last year, an infrared detector was added, whose output was displayed on a television screen inside the cockpit and recorded for later reference. Called FLIR—forward looking infrared—the device was developed for seeking out an enemy at night and got its name because it was designed for installation in the nose of a plane. Initial trials demonstrated its importance dramatically: A week after major fires in the Angeles National Forest, last November, a FLIR equipped helicopter discovered several areas of glowing material that had crossed control lines, ready to kindle a new conflagration.

Shields says the use of NVG and FLIR in land management is just beginning. Research into the habits of nocturnal animals is likely to be an early additional application. Already NVG's have been used to catch people using the cover of darkness to poach trees for Christmas.

Help for night blindness

At a price of over $10,000, night vision goggles are still too expensive to help the estimated 100,000 to 200,000 people in the United States that suffer from retinitis pigmentosa—an inherited disease whose first symptom is night blindness. A number of companies have tried to produce cheaper versions; the latest is a device announced at the Reston meeting by ITT Electro Optical Products Division. The so-called Night Vision Aid was developed by James H. Burbo of ITT in conjunction with the National Retinitis Pigmentosa Foundation. It sells for around $3,500.

Light amplification did not need to be as great as that required in the military prototype. Thus the final product is extremely light weight, has a rechargeable battery, fits in the palm of the hand and has the light gain set at the factory according to the doctor's prescription. A small light-emitting diode is attached to allow a patient to search for keys, and so forth, in total darkness.

Because of the relatively low price, other users are expected to quickly enter the market. The Forest Service and some security companies have already begun to show interest. Burbo told SCIENCE NEWS he hopes the price can come down another factor of two as production picks up.

Finding fish by the glow

One of the most unusual applications of image intensification devices was described by William Dyer of Baird-Atomic, Inc. His company was asked by commercial fishermen to develop an instrument that could spot schools of fish at night, from an airplane, by detecting the faint glow of bioluminescent organisms excited by the passage of the fish.

The problem turned out to be not so much one of sensing the faint glow as discriminating it from extraneous sources—lights on boats, reflections on the water, and so forth. Eventually the problems were solved and the unique instrument was apparently functioning quite well—until a pilot exhausted from hours of flying around looking for glows destroyed the device's housing by landing his plane without remembering to lower the wheels.

Next, the mini-laser

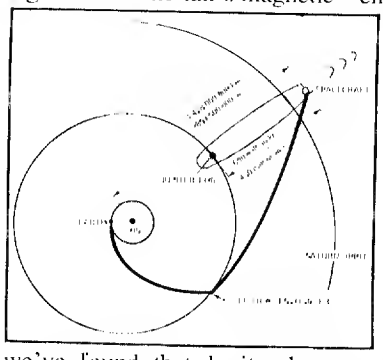
Solid-state lasers have, until now, presented engineers with a peculiar dilemma—the "doped" kind have to be relatively large, to dissipate heat; the semiconductor kind can only be very tiny. What has been missing is a powerful inexpensive, "mini" sized laser. Talk around the conference centered on a new breed—the rare earth-pentaphosphate laser—as a likely candidate.

In so-called "glass" lasers, a tiny amount of optically active dopant, usually neodymium, is widely dispersed through a glass matrix, limiting the power density. If more than a few percent of neodymium is added, the glass breaks from thermal stress. But in the new pentaphosphate medium up to 50 percent of neodymium can apparently be used, so that for a given power level, the size is greatly reduced. So far the new lasers are relatively hard to fabricate, but one scientist speculated that they may one day become cheap, "nearly throwaway" devices.

SPACE SCIENCES

The titanic tail of Jupiter

The Pioneer 10 spacecraft, which flew past Jupiter in December 1973, has apparently flown through the tail of the giant planet's magnetic field 690 million kilometers further from the sun than Jupiter itself, outside even the orbit of Saturn. It happened on March 19, when the spacecraft's solar wind detector dropped to a zero reading for more than 24 hours. Such a reading signifies that the tail's magnetic "envelope" may have shut out the solar wind particles.



"It is just barely conceivable that the solar wind could have died completely for a whole day without our being in the tail," says Pioneer project scientist John Wolfe of NASA's Ames Research Center, "and we'll know more when we have complete tracking data. But we believe we've found that Jupiter has a very stretched-out magnetic envelope, or tail." There was also some speculation that Pioneer 10 might merely be in a "magnetic bubble" broken off from the tail, but Wolfe believes that the long duration of the zero-solar-wind period means that the spacecraft crossed an intact portion of the tail. If so, Jupiter's magnetotail is at least 10,000 Jupiter radii in length, compared with about 1,000 earth radii for earth's magnetotail. Saturn should enter Jupiter's magnetotail every 20 years. When that happens—as it will next in April 1981—Saturn's outer radiation belt should be disturbed. Spacecraft may attempt to monitor evidence of that event.

In addition, when Pioneer 10 crossed the Jovian magnetotail, it was 6 degrees—about 100 million kilometers at that distance from the sun—above the plane of the ecliptic. Pioneers 10 and 11 have both detected enough solar wind turbulence at Jovian distances and beyond to account for the wind's blowing the magnetotail "upward" by that amount.

Another origin for the moon

No Lunar Science Conference, such as the one at NASA's Johnson Space Center in Houston two weeks ago (SN: 3/27/76, p. 196), would be complete without a new theory of the origin of the moon. A key constraint on such theories, according to A.G.W. Cameron and W.R. Ward of the Center of Astrophysics in Cambridge, Mass., has to be the "abnormally large" specific angular momentum of the earth-moon system compared with the other planets in the solar system. At an early stage, when the moon was close to the earth, most of the angular momentum resided in the earth's spin, a spin, they suggest, presumably imparted to the protoearth by a collision with a major secondary body possibly as massive as Mars.

The protoearth and the secondary body, they theorize, both had iron cores and silicate outer layers. The silicates would have vaporized and blown off, while the iron would have fragmented and collapsed back to the earth (thus accounting for the still-unexplained paucity of metallic iron on the moon), leaving the silicates to condense into a disklike ring similar to that proposed in the past by A.E. Ringwood of the Australian National University. The disk would then condense into the moon.

The resulting moon would be deficient in volatile elements (as Apollo data indicate), because most of the fine grains into which the volatiles condensed would have been driven completely out of the system by the rebound energy following the collision. There would also be a slight enrichment in crustal elements such as calcium and aluminum relative to the earth. Cameron estimates about 2 to 1, which is not inconsistent with recently revised lunar heatflow measurements.

This theory, say the authors, applies only to a planetary body such as the earth, where the escape velocity is sufficient to vaporize silicates. "If a similar large collision happened in the late stages of accumulation of Venus," they report, "the orbit of any satellite formed would have decayed into the planet long ago."

Safer facility sought for moonrocks

With interest in the Apollo lunar samples still high and with no return visits yet in sight, lunar researchers are seeking an improved curatorial facility to provide safer storage and more workspace for the priceless rocks. Participants at the Lunar Science Conference in March were signing petitions in support of funding for the facility. Funds were not approved by the House of Representatives but have been endorsed by the Senate space committee. The proposed facility, an addition to the present one at Johnson Space Center, would be designed to resist flooding and other adverse environmental characteristics of the area.

Five new satellites in orbit

Five separate U.S. space satellites, representing both military and civilian interests, have been launched into orbit recently, four of them aboard a single rocket.

Two Naval Research Laboratory satellites, SOLRAD (SOLar RADiation) 11A and 11B, were sent aloft March 14 to measure the sun's X-ray, ultraviolet and proton emissions as well as solar wind fluxes. Since SOLRAD 1 was successfully orbited on June 22, 1960, the ongoing program has provided reams of data, including such milestones as the passage of SOLRAD 8 through an eclipse shadow over Greece in 1966. Part of the solar-flare alert network, SOLRAD 10 was standing watch during the Apollo lunar missions and later during Skylab. The latest satellites in the series will provide data to a system that uses solar X-ray flux to help predict the duration and intensity of fadeouts in shortwave radio communications.

The same Titan IIIC rocket that carried the SOLRAD probes also lofted a pair of Lincoln Laboratory Experimental Satellites, LES 8 and 9, built at the MIT facility for the U.S. Air Force. Powered by nuclear generators rather than conventional batteries or solar cells, the devices are helping to evaluate techniques of "satellite survival and dependability in a hostile environment," using such aids as signal processing circuits designed to resist electronic jamming.

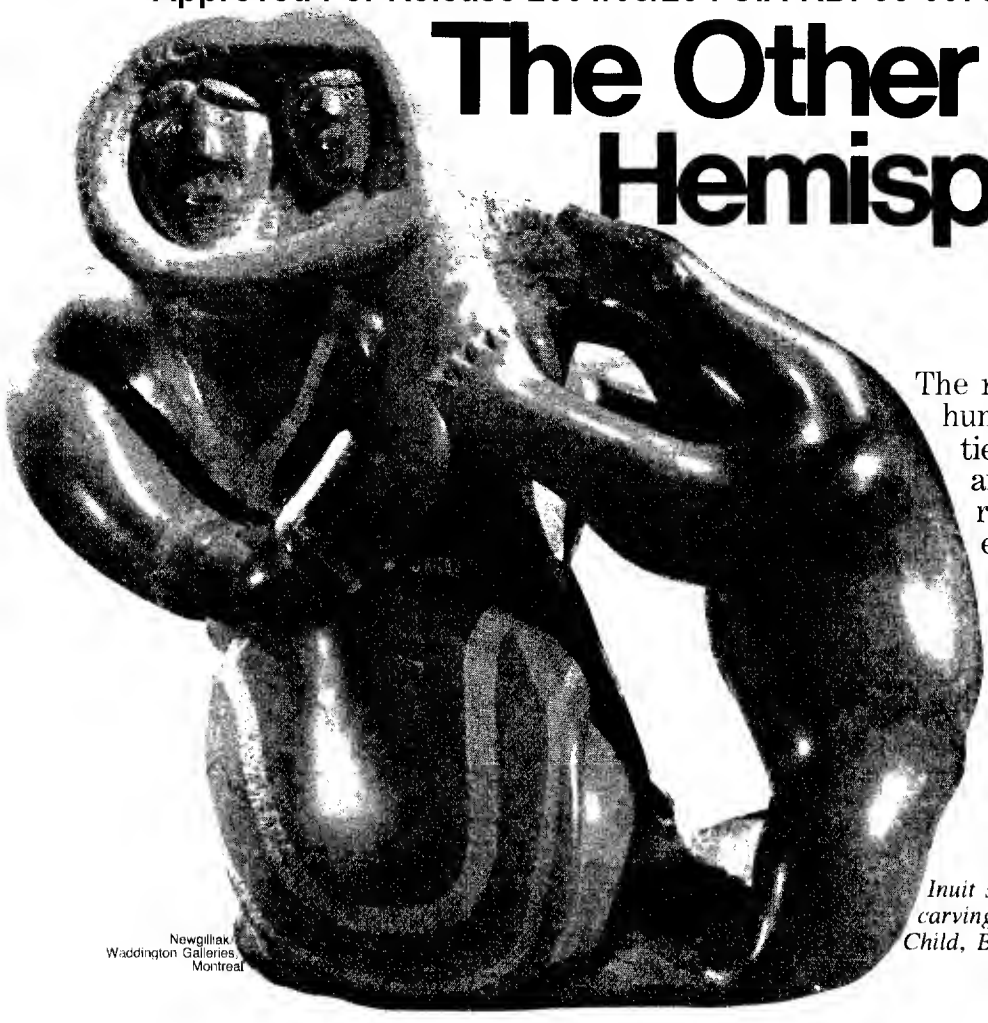
In the private sector, the second of RCA Corp.'s commercial, domestic communications satellites, Satcom II, was launched March 26 to provide voice, television and data relay for the contiguous United States and Alaska. Satcom I, launched Dec. 12, is now in synchronous orbit over the equator at about 119°W, due south of Los Angeles. Satcom II was aimed at about 135°W, south of Juneau, Alaska.

Last man on the moon to retire

Irony. It was on the first day of this year's Lunar Science Conference that NASA announced the July 1 retirement of veteran astronaut Eugene A. Cernan—the last man on the moon. Cernan, who walked in space during Gemini 9 and flew the Apollo 10 lunar module to within 10 miles of the moon's surface, followed astronaut Harrison H. Schmitt up the LM ladder as they prepared to return to earth aboard Apollo 17 from the moon's Sea of Serenity.

Of the 12 men who have walked on the moon, only three, after Cernan, will still be with NASA: Alan Bean (Apollo 12), David Scott (Apollo 15) and John Young (Apollo 16), and only Bean and Young remain on flight status.

The Other Hemisphere



Newgillak, Waddington Galleries, Montreal

Inuit soapstone carving: "Woman, Child, Bear"

The right hemisphere of the human brain has special qualities. Brain specialists, anthropologists and other researchers pool their evidence to delineate them.

BY ROBERT J. TROTTER

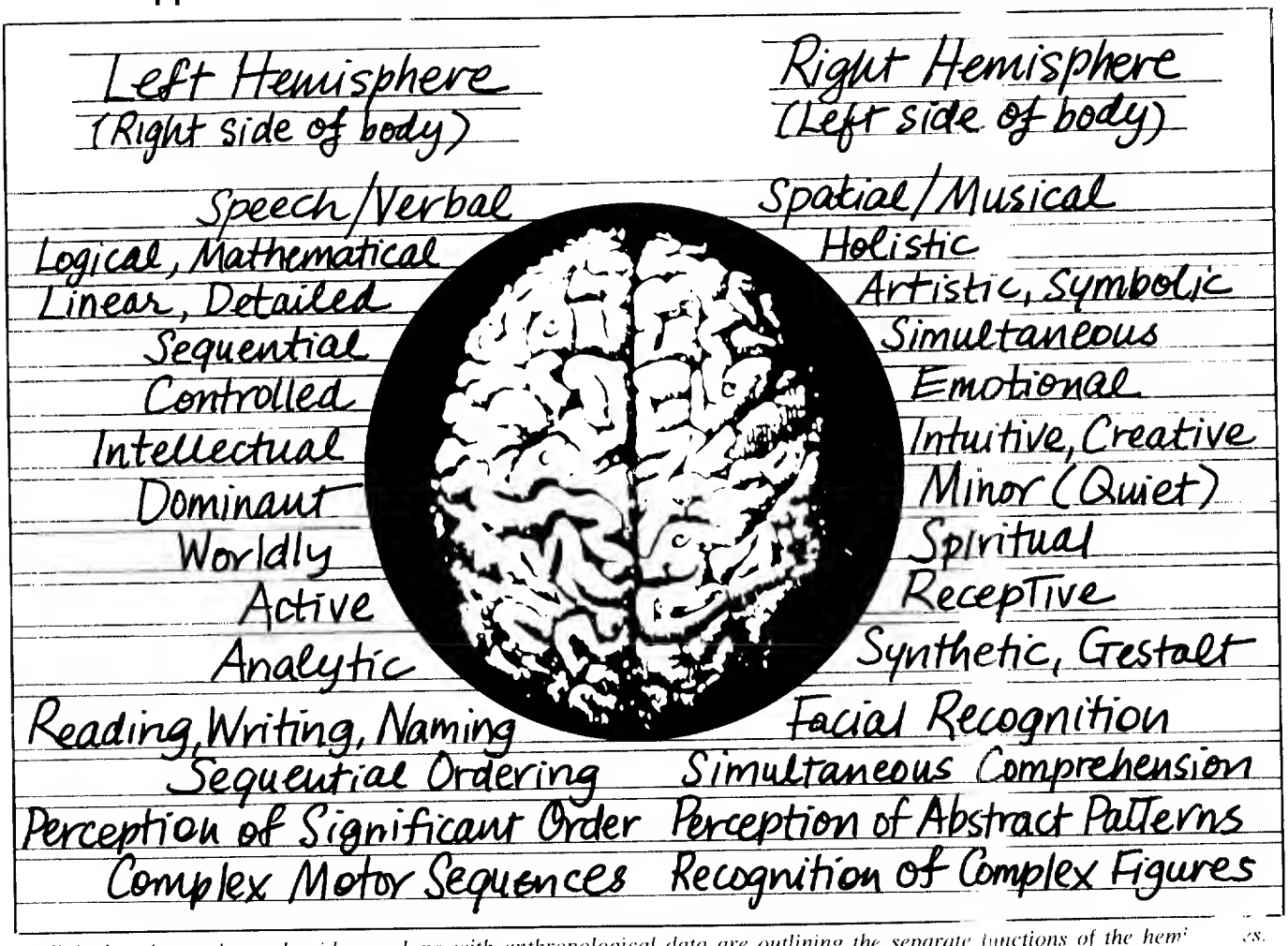
Of all the frontiers science has yet to conquer, of all the mysteries it has yet to unravel, one of the most exciting and possibly the most important is the still uncharted human brain. Rising to meet this challenge are thousands of researchers in a number of diverse fields, each coming at the brain from a slightly different angle. Neuroscientists, brain anatomists, electrophysiologists, biochemists and other specialists in the physical sciences are all probing the brain in attempts to understand what it is and how it works. But investigations of the brain itself do not give the whole picture. Mapping the brain from an entirely different but equally valid perspective are the behavioral scientists who hope to get a better understanding of the human brain by examining not what it is but what it produces—human behavior.

Along these lines, an investigation was conducted last summer among the Inuit or Eskimo people of Baffin Island in northeastern Canada. The project, directed by anthropologist Solomon H. Katz of the University Museum of the University of Pennsylvania, dealt specifically with one of the most fascinating and fastest growing areas of brain research, cerebral asymmetry or hemispheric dominance. The researchers (including another anthropologist, a psychologist and a psychiatrist) studied the environment, lifestyle, socialization processes, art objects, eye movements and hand use of the Inuits and found what appear to be important correlations between all of these and the activity of the brain's right hemisphere.

To the naked eye, the halves of the human brain look almost like mirror images of each other, but for more than 100 years it has been known that the right and left hemispheres function differently. In 1861, Pierre Paul Broca, physical anthropologist and a founder of modern brain surgery, localized the center of articulate speech in an area of the left frontal cortex now known as Broca's area. In 1874, Carl Wernicke discovered a sensory speech center in the left hemisphere. It is concerned with the comprehension of language and is now known as Wernicke's area. Lesions in these two portions of the left hemisphere were found to cause various types of aphasia, the loss or impairment of the ability to use words as symbols or ideas.

Speech is only one ability that the hemispheres do not have in common. People who have suffered neural damage to one or the other hemisphere show a number of behavioral differences that have helped researchers delineate functional areas of the brain. An accident involving the left hemisphere can impair speech or produce aphasia. Damage exclusively to the right hemisphere does not usually disrupt linguistic abilities but can lower performance in spatial tasks, simple musical abilities, recognition of familiar objects and faces and bodily self awareness.

Since these discoveries were made, and especially in the past 20 years, the whole field of research into the differing functions of the hemispheres has blossomed. It was in 1953 that Roger W. Sperry began his far-reaching "split-brain" research. Working with Ronald E. Meyers at the California Institute of Technology, Sperry performed split-brain operations on cats. The corpus callosum, the bundle of nerve fibers that connects the hemispheres, was surgically severed, and the sensory inputs from the eyes were rearranged so that each eye fed information to only one hemisphere (instead of to both as is normally the case). After recovery from surgery, the animals were taught to solve various visual problems with one eye (and hemisphere) or the other. With the left eye blindfolded, the cat learned with its right eye and hemisphere only. When retested with the blindfold switched to the other eye, the cat showed no signs of having learned. After the corpus callosum was severed, the left hemisphere did not know what the



Clinical and experimental evidence along with anthropological data are outlining the separate functions of the hemi es.

right was learning and vice versa.

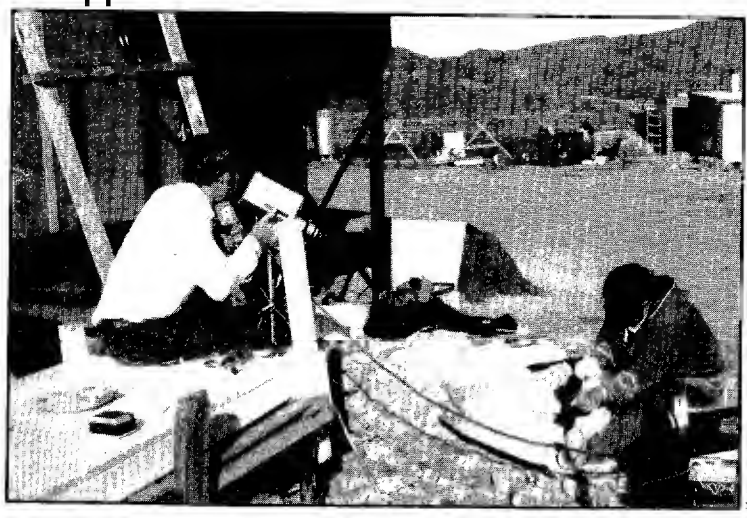
These split-brain experiments showed that the hemispheres of the brain can function independently when surgically separated. Once this was demonstrated, it became possible to use the split-brain technique to investigate various aspects of cerebral organization. But cats don't talk, and true cerebral asymmetry is not thought to exist in animals (though recent evidence suggests the possibility of hemispheric specialization in some monkeys and songbirds). It was not until the split-brain procedure was used on humans that it became possible to be more exact in descriptions of the differing functions of the right and left hemispheres of the human brain.

In the intact brain, constant communication must be maintained between the hemispheres because each side controls only one half of the body, the opposite half. If the left hemisphere decides to take a walk, this decision must be signaled not only to the right side of the body but to the right hemisphere—which in turn activates the left side of the body and produces coordinated walking. The connection between the hemispheres is made through the corpus callosum, but this arrangement does not always work to the brain's advantage. An epileptic seizure originating in one hemisphere, for instance, is communicated to the opposite side of the brain (and then back and forth and back and forth), making the seizure much more severe. In some of the worst of these cases, the split-brain operation has been used to contain the epileptic activity to only one hemisphere.

It is these split-brain patients who have added greatly to our growing knowledge of the specific functions of the hemispheres. Sperry and others have reported that the left hemisphere is involved in logical, analytical, linear and sequential (especially time-bound) thought processes and specifically mathematical and linguistic abilities. The right hemisphere is involved in spatial relations, musical (tonal qualities), artistic, simultaneous (not constrained by time) and holistic thought processes.

Brain damage and surgical techniques have been important in mapping the brain, but there are more subtle approaches. Handedness and eye movements have been found to be fairly reliable signs of hemispheric activation. Since the brain seems to have two "minds" that can operate independently and differently, it has been assumed that one hemisphere must be dominant. Depending on the activity involved, one hemisphere or the other must take the lead and maintain control in order to ensure coordination. Because most people are · ded (left brained), and because · ech centers are almost always located in the left hemisphere, that hemisphere has usually been considered "dominant" while the right hemisphere has been called "minor" or "quiet." (Approximately 10 percent of all people are left handed. About half of these are thought to be truly biologically left handed. That is, their speech centers are located in the right hemisphere.)

But the left hemisphere does not always control, and there appear to be degrees of dominance. The amount of right hemisphere activation seems to vary from individual to individual. This is where lateral eye movement (LEM) comes in. When asked a question, people will often glance slightly to the right or to the left before answering. The direction of this initial gaze is thought to be an indication of hemispheric activity. Investigators have found that right LEM's (left hemisphere) are usually associated with verbal and sequential processes while left LEM's (right hemisphere) are usually related to spatial tasks. Recent research has also linked the right hemisphere with emotional processes (SN: 10/18/75, p. 244), and there are indications that the right hemisphere may be involved in such things as creativity and intuition. Meditation, hypnosis and drug use (alcohol,



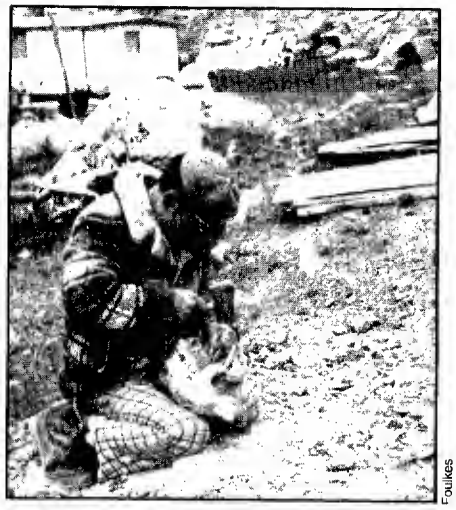
Katz

Katz uses videotape to record the eye movements and hand use of Inuit carvers at work. Left hand (right hemisphere) positions sculpture while detailed work is done with right hand.

marijuana and cocaine) have also been mentioned in association with right hemisphere activity. It has been suggested, for instance, that some types of drug use may be related to attempts to temporarily free the right hemisphere from the left's dominance in order to produce states of consciousness associated with the right hemisphere. "Spaced out" is a term that applies. And in typical right hemisphere fashion, it offers an integrated impression rather than an analytical description of a state of mind.

It seems likely, says Katz, "that, depending on the activity, normally the brain selectively uses one or the other hemisphere more or less during the performance of various motor activities. In a sense, while we are carrying out one activity, we may be selectively screening out another—perhaps as a child who when spoken to in the midst of daydreaming hears the words but does not know what has been said. Perhaps only in unusual circumstances do we break through to use both hemispherical modes in focused, coordinated fashion, as in a flash of insight, as when Archimedes said 'Eureka!' When this occurs, there is certainly a great deal of exhilaration, a new kind of high point—an 'epiphany,' as James Joyce once called it."

Another line of evidence (still somewhat circumstantial) has to do with patterns of human cognition as seen in different societies. It may be possible, says Katz, to carry out cross-cultural studies of practices that reflect upon the theme of asymmetries in cerebral function. All we have to do, he explains, is determine if various societies have information in their belief systems about the kinds of behaviors expected to be associated with left and right hemispheric functions. Katz has drawn up a list of such behaviors based on the anthropological literature (see ZYGON, vol. 10, no. 1, 1975, a publication of the University of Chicago). In general, he found the left hand and side of the body (right hemisphere) to be associated with the symbolic, ritualistic, mystical, mythical, omnipotent, tran-



Foulkes

scendental, supernatural, evil, profane, foreign and alien. The right hand is typically associated with social order, politics, organization, social system, morality, goodness, sacred, explicitly verbal, mathematical and ordered.

Katz admits that such a list of behaviors related to one hemisphere or the other is only intuitive at present but suggests that anthropological studies will at least produce hypotheses for testing by neuropsychologists. And with that as background, he and his colleagues set out to study cerebral asymmetry among the Inuits in Frobisher Bay and Lake Harbor. (The research was supported by William and Jane Hitchcock of New York.)

If variations in cognitive style emphasizing one kind of thinking over another are possible, says Katz, one of the most likely groups manifesting orientation to right hemispheric functions would be the Inuit Eskimos. They are known for their unusual gestalt (integrated) abilities, such as drawing accurate maps of their territories. They seem to have a sort of symbiotic feeling of oneness with their environment and have traditionally depended on their well-documented ability to find their way out of the most incredible circumstances. Such abilities would probably be highly adaptive in an environment like the Arctic, which demands a high degree of visuospatial ability for survival. In short, says Katz, it would appear that these right hemisphere functions would be more highly developed in Eskimos than in modern urban populations.

The Eskimo language also reflects a high degree of spatial, right hemispheric orientation. Linguistic studies rate it as being the most synthetic of languages. American English is at the other end of the same scale and is rated as the most analytic (left hemisphere).

The Inuit people are also known for their soapstone and whalebone sculptures, wood cuts, lithographs and tapestries. This artwork has been described as "voluptuous, symbiotic and timeless in character." Figures on tapestries and in lithographs are often seen floating helter-skelter without apparent linear or three dimensional analytic orientation. This art (especially the sculpture) not only provides additional evidence for the Inuit's spatial abilities but also affords researchers a unique opportunity to observe people carrying out work that demands tremendous spatial skills. "Hence," says Katz, "by observing and recording [videotaping] how the stone carvers use their hands and eyes in carrying out their work, we can determine if the special spatial and synthetic abilities resident in the right hemisphere are playing an important role in the creativity expressed in their carvings."

While the researchers have not finished analyzing all of their records, several clear findings have emerged that are highly suggestive of a specific role for the right hemisphere. Among the Inuit carvers (all of whom were right handed), the left hand cradles the work, moves it into new positions and feels its progress while the right hand precisely carves the details and holds the various carving tools. Even when a tool could be placed down, the left hand carried out the repositioning of the stone in space. Also, as predicted, there was a striking preponderance of holding the stone in the left visual field (right hemisphere).

These observations suggest hemispheric symmetry or at least a high degree of cooperation between the hemispheres. Katz finds an "almost perfect relationship between the right hand doing the detailed, analytical kinds of activities and the left hand doing all the spatial and touch activities. The Inuit artists produce some phenomenal representations, he says, with the left hand doing some remarkable things.

Specific conclusions from these observations are hard to reach at present, but there are some interesting implications. The Inuit environment, language and certain social behaviors (such as their emphasis on teaching by demonstration rather than by verbal instruction) all seemingly combine to foster right hemi

Continued on page 223

OFF THE BEAT

Don't Let Toxic Chemicals Go To Your Head

Anne Lunsford

Day after day scientific labs churn out more devastating information about the toxic potential of the 50,000 drugs, 36,000 pesticides, 7,000 food additives and hundreds of thousands of other chemicals in the American environment. Vinyl chloride, heptachlor, chlordane, DDT, menopausal estrogens, Red No. 2 cause cancer; sulfur dioxide, carbon monoxide and photooxidants trigger asthma and heart attacks; birth control pills induce stroke; cigarettes lead to emphysema and lung cancer—ad nauseam. If you're concerned about what all these chemicals are doing to you, take heart; this disseminator of the bad news worries, too. In fact, her head is reeling from a toxic chemicals overload!

If you think I'm kidding, consider some of the anxieties that have run through my head in the course of a day. First off, I crawl out of bed, my thoughts turning to the aroma and taste of freshly ground and brewed coffee. Yum. Then I think—uh, oh—not more than two cups. Otherwise I might be courting bladder cancer, peptic ulcers and heart disease. As I make my way to my little kitchenette, a cockroach invariably greets me. I reach for my trusty pesticide can and let him have it, wondering what chronic pesticide exposure is doing to *my* brain and nervous system.

In the bathroom I down some vitamin C pills to ward off a cold I'm getting and to counter the extra stress I expect that day. Then I recall that I took some aspirin earlier and that the vitamin C might keep the aspirin from being eliminated from my body. Now it's off to work. As I pass the District of Columbia Lung Association building, a sign in the window reminds me that the air pollution index is dangerously high. Now I wish I'd taken a vitamin E pill to counter the smog.

Comes lunchtime—must make sure that I eat enough protein, vitamins, minerals and unsaturated fats to prime my liver enzymes so that they rid my body of dangerous foreign chemicals. And enough raw vegetables and whole grain products to expedite waste products through my body and avoid rectal cancer. After work I hold my breath as a bus expels toxic fumes in my face. Back in my apartment I reach for a cocktail. Too late I remember that I just took an antihistamine, and that it enhances the depressive effects of alcohol, causing drowsiness, mental dullness and inability to concentrate.

What I suspect is that many of us are letting toxic chemicals go too much to our heads. And the culprits are no less than scientists and science funders who publish bad news in scientific journals without providing perspective on it.

For instance, scientists have used gas chromatography to detect pesticides in people in parts up to a billionth. But pesticides in such tiny amounts may not necessarily be doing anything baneful to the body. Then there is the grave danger of applying laboratory dress-rehearsals—tissue culture and animal experiments—to the human situation. Different cell lines and animal strains can react differently to the same chemical. Dosing animals with enormous amounts of chemicals is nearly always going to produce toxic effects. But how often are people exposed to such large doses? For instance, the defoliant 2,4,5-T was used to clear jungles in Vietnam during the Vietnam war. This chemical induces birth defects in mice and rats. But it has never been proved—spite of extensive efforts—that the chemical caused birth defects in Vietnamese children. And even supposing that chemicals were present in the human body in such large amounts as used in animals, how long do they stay there? In what forms? The reason DDT is relatively harmless to people is that it is quickly broken down by liver enzymes into DDE, a less toxic metabolite.

Even Government regulatory agencies have serious doubts over whether their lab tests can be extrapolated to people. For instance, it took the FDA 10 years to decide that Red No. 2 should be removed from the market. And apparently the most convincing reason for doing so was that high doses of the dye increased tumors in a sensitive strain of laboratory rats. At the same time FDA Commissioner Alexander M. Schmidt said that foods on the market containing the dye could be sold until they were used up "because there is no evidence of a public health hazard."

And how about the good aspects of the many chemicals in our environment? Scientists rarely receive grants to explore the benefits. Yet without many of these chemicals our lives would be far less pleasant, comfortable and even, in many cases, less healthful. Alcohol is knocked for all its evils, but it can also restore the nasal mucosa and speed the flow of blood to the heart. Although a witch-hunt is on to condemn marijuana, Harvard investigators recently found that it can improve the appetites of cancer patients who suffer from nausea due to chemotherapy.

Now don't get me wrong. I know that there are very real toxic threats in our environment—lead poisoning in children, mercury poisoning in Japan, the kepone pesticide tragedy among workers in Hopewell Va. Last August, state officials warned consumers not to eat bass from the Hudson River or salmon from Lake Ontario because researchers had found that the fish contained dangerously high levels of polychlorinated biphenyls (PCB's). Very young and old persons do not have the same liver-enzyme defenses against toxic chemicals that the general population does. Some persons were born with genetically defective liver enzymes. Improper diet can also impair the liver enzymes. I *do* advocate taking reasonable precautions against toxic chemicals: eating a wholesome diet, e.g. natural, whole grain cereals instead of those larded with sugar and additives; telling the cigar smoker in the no-smoking section of the Metroliner where to get off; riding a bike instead of driving. (I once was the only person who came to an air pollution conference by bike; the scientists came by car.) What I *am* arguing for is that we stop letting the spate of bad news about toxic chemicals warp our perspective, wear down our health and use up our precious leisure hours.

For example, how many gallons of spring water should you lug from the supermarket to avoid toxic chemicals in drinking water? (I made it through seven.) How many hours should you devote to hand-picking bugs off tomato plants to avoid using a pesticide? (I made it through 15 minutes.) How many days should you stay in bed to avoid a high air-pollution index? (I've never stayed home one. Otherwise, I wouldn't be able to bring you all the bad news about toxic chemicals that is crying to be publicized.)

And it is especially time, in this bicentennial year, that we stop letting toxicologists and company deprive us of our American right to the pursuit of happiness. As one doctor laments: "They *can't* find that coffee causes cancer too. It's the only pleasure that I have left."

—*Joan Arehart-Treichel*

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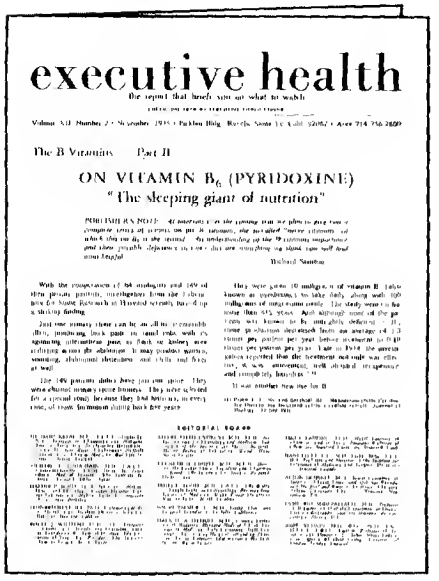

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. . . Right Hemisphere

sphere activity which shows up in the Inuit life style and artwork. This suggests that modes of thinking (or hemisphere use) can be taught. It is possible that different cultures channel people into a greater or lesser reliance on one or the other hemisphere. This may eventually be confirmed as the workings of the brain are further elucidated, but even then will it have any practical import?

Several researchers have addressed this question, and as scientists so often do, they seem to be searching for symmetry:

- Robert Hertz, in 1909, in a classic sociological article on the preeminence of the right hand: "If the constraint of a mystical ideal has for centuries been able to make man into a unilateral being, physiologically mutilated, a liberated and farsighted society will strive to develop the energies dormant in our right cerebral hemisphere and to assure by an appropriate training a more harmonious development of the organism."
- Jerome S. Bruner, experimental psychologist at Oxford University: "Since childhood, I have been enchanted by the fact and the symbolism of the right hand and the left—the one the doer, the other the dreamer. The right is order and lawfulness, *le droit*. Its beauties are those of geometry and taut implication. Reaching for knowledge with the right hand is science. Yet to say only that much of science is to overlook one of its excitements, for the great hypotheses are gifts carried in the left."
- Roger W. Sperry, in the National Science Foundation's March/April 1976 MOSAIC (an excellent overview of the current state of brain research): "Our educational system and modern society generally (with its very heavy emphasis on communication and on early training in the three Rs) discriminates against one whole half of the brain. . . . In our present school system, the attention given to the minor hemisphere of the brain is minimal compared with the training lavished on the left or major hemisphere."
- Solomon H. Katz, speaking of right hemispheric thought processes: "Certainly, the absolutely abundant anthropological evidence that supports their manifestations from the intuitive perspective indicates that our implicit knowledge of these phenomena may be as old as humanity itself. But what is different and truly exciting this time is that we can now begin to use the knowledge as a regular part of our *scientific* understanding of the human mind in order to extend further our means of adapting to the world we live in. . . . At last, our newly developing science of humanity can potentially set us free to recognize that there is more to humanity than all of our linear thinking can give us and to realize that human life viewed predominantly from left hemispheric functions is almost as flat as viewing the world through one eye." □

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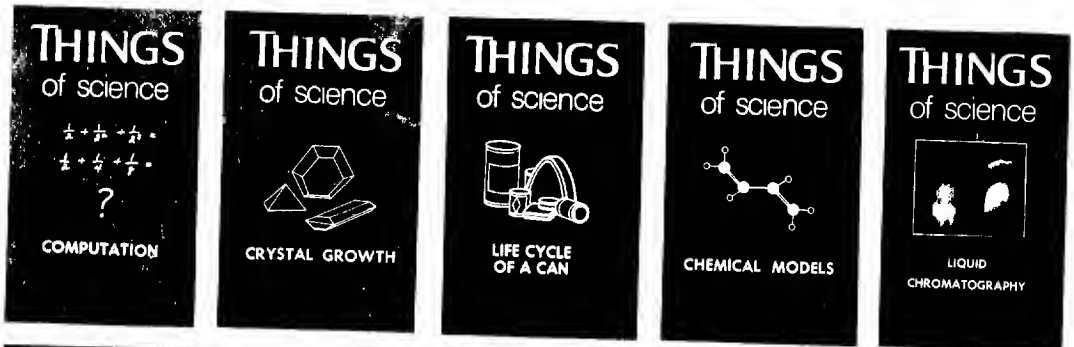

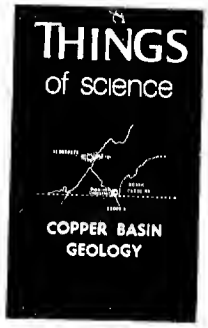

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